APPENDIX F

Environmental Resources and Needs

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

FACTORS AFFECTING WETLANDS

Factors which influence wetland systems include hydrology, fire, geology and soils, climate, and ecological succession. This section presents an overview of each of these factors.

Hydrology

Hydrology is the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes (Mitsch and Gosselink, 1986). Hydraulic inflows and outflows, such as precipitation, surface runoff, ground water inputs, and in some cases, tides and river flooding, provide the energy to transport nutrients and other organic material to and from wetlands. Water depth, hydroperiod, flow patterns, stage, duration, frequency of flooding and water quality all influence the biochemistry of wetlands and ultimately, the species composition and type of wetland community that develops. The hydrology of a wetland acts both as a limit and a stimulus for determining the numbers and types (species) of flora and fauna that can live within or utilize a specific wetland. Hydrology also strongly affects aquatic primary production, organic accumulation, and the cycling of nutrients (Mitsch and Gosselink, 1986).

Precipitation

The UEC Planning Area experiences wide variations in annual rainfall, resulting in both flooding and extended drought periods. During heavy rainfall years, there is overland flow and discharge to the ocean. During extended drought years, however, the natural system is stressed by saltwater intrusion, increased frequency of fires, loss of organic soils, and invasion of wetlands by exotics.

Evapotranspiration

Evapotranspiration (ET) is the combined process of evaporation from land and water surfaces, and from plants. ET rates vary as a function of solar radiation, air and water temperature, relative humidity, wind velocity and duration and the type and density of vegetation (Duever et al., 1986). In south Florida, ET ranges from 70 to 95 percent of annual rainfall. During the dry season and drought years, ET exceeds rainfall inputs (Klein et al., 1975). Temperature is often regarded as the most important factor controlling ET. Minimum ET rates occur during the winter months of December and January, with highest values experienced during the spring months of April and May. Typical ET values for south Florida range from 40 to 45 inches a year, up to a maximum of 60 inches a year (Parker et al., 1955). ET rates frequently account for virtually all water losses in a wetland because of their slow rate of flow and high surface area to depth ratio (Mitsch et al., 1988). As a result, ET plays a very important role in the development of any hydrologic model that might be developed for a particular wetland system and is usually the most difficult parameter to estimate. Wetlands have higher ET rates than other habitats largely because they store water at or near the ground surface where it can be lost to the atmosphere (Duever, 1988).

Hydroperiod

Hydroperiod refers to the annual period of water level inundation, specifically the depth and length of time (duration) that a wetland contains water above ground level. Figure F-l presents examples of typical hydroperiods experienced by three different south Florida plant communities. Duever et ***al.*** (1986) reports that hydroperiod is the dominant factor controlling both the existence, plant community composition and succession of south Florida wetland systems. Hydroperiod is often expressed in terms of the range of the number of days that a wetland is normally inundated. Each wetland type is thought to have a hydrologic signature that describes the rise and fall of water levels from year to year (Mitsch and Gooselink, 1986). In contrast, O'Brian and Ward (1980) state that from a hydrological point of view, the most significant feature of a wetland is the level of the ground water table. They point out that the depth to the ground water table is more significant than the hydroperiod or time the wetland is flooded.

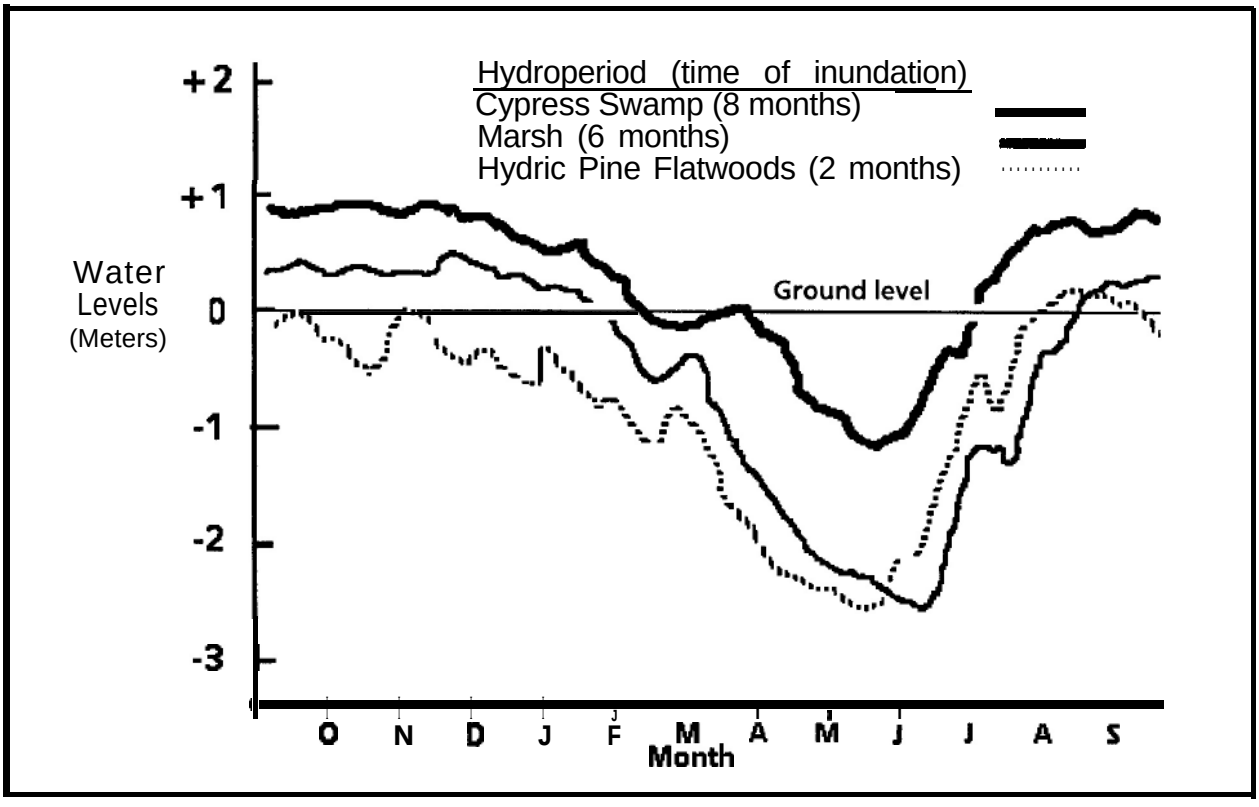

FIGURE F-l. Hydrographs and Hydroperiod Ranges for Three Different South Florida Vegetation Types (From Duever et al., 1986).

Water Level Depth and Timing

In south Florida's freshwater wetlands, wading bird nesting success is highly dependent on present and past water level conditions, which influence the amount and availability of wading bird prey items, such as crayfish and small forage fish (Kushlan, 1976, 1978, 1979, 1980, 1986; Powell, 1987. Kahl (1964) found that the timing and initiation of wood stork breeding attempts was predictable from the measurement of marsh surface water levels. Kushlan et al. (1975) found that wading bird nesting success was directly related to the rapid winter/spring recession of water levels (drying rate) of south Florida wetlands. Therefore, maintenance of appropriate water depths and timing of wetland water level fluctuations is a critical factor in determining wading bird nesting success.

Topography

In general, wetlands in temperate and tropical regions tend to develop in areas of low topographic relief and high rainfall inputs. Topography also controls the shape and size of watersheds, and affects the timing and quantity of runoff. Topography is also an important factor in controlling the vertical and horizontal extent of seasonal water level fluctuations within a wetland. At the site-specific level, wetlands are determined by the depth and duration of inundation, which in turn are influenced by site microtopography (differences in water depth of only a few centimeters), soil type, and vegetative cover (Duever et al., 1986).

Vegetation Type

Vegetation type can affect the hydrologic cycle of a wetland, primarily through ET. Vegetation also influences water movement and water quality. Plant leaves, leaf litter and attached periphyton (algae) communities tend to impede water flow which: (1) increases the period of inundation, (2) reduces surface water runoff and erosion, (3) allows more time for aquifer recharge, and (4) assimilates nutrients and chemical exchanges between the soil vegetation and water (Duever et al., 1986).

Tropical Storms and Hurricanes

Hurricanes, tropical storms which generate winds in excess of 75 miles per hour, are recurrent events in south Florida and are important physical processes which affect the regional ecology (Craighead and Gilbert, 1962). Hurricanes normally cause the greatest amount of damage when wind velocities average greater than **111** miles per hour. They also have the potential of producing massive quantities of precipitation in a very short period of time.

Fire

Fire is also an important factor controlling the species composition, distribution and succession of wetland communities in the planning area. Within the constraints of wetland hydrology, fires occur with variable frequency and severity affecting plant succession.

Theoretically, hardwood hammocks represent the climax plant community for south Florida (Alexander and Crook, 1973; Wharton et al., 1977; Duever, 1984). Hammocks develop when fire is absent or infrequent, and organic soils are allowed to build up over time to support the succession of hardwoods. However, fire is a common component of the south Florida landscape.

Ewel and Mitsch (1978) investigated the effects of fire on a cypress dome in Florida. They found that fire had a cleansing effect on the dome, selectively killing almost all of the pines and hardwoods and yet killing relatively few pond cypress, suggesting a possible advantage of fire to some shallow cypress ecosystems in eliminating competition that is less water tolerant (Mitsch and Gosselink 1986).

Geology and Soils

The primary geological feature that controls regional hydrology is the permeability of the underlying rock. Quartz sand, clay and shell with stringers of limestone comprise the underlying aquifer.

Two primary factors which affect the hydrogeology of wetlands are the porosity and permeability of its underlying soils (Duever, 1988). A highly porous soil can hold or store large amounts of water, while a highly permeable soil allows water to flow to the underlying aquifer. The high capillary action of peat or clay soils enable wetlands to store large quantities of water, somewhat similar to how a sponge takes up water.

Some wetlands contain perched water tables. A perched water table exists where a saturated soil layer is found above a water table and is separated from it by an unsaturated zone (Freeze and Cherry, 1979). This can occur where a relatively impermeable clay or organic soil layer is present near the ground level and restricts the downward movement of water. Perched water tables come in various sizes and can influence surface water levels over large areas or have only local, temporary effects (Duever, 1988). A common misconception is that wetlands can only occur on sites containing a perched water table.

Climate

In addition to hydrology and fire, climate also plays an important role in controlling plant community succession. The area1 extent, species composition, and existence of wetlands are all affected by long-term climatic changes. In addition to normal cyclic drought and flood conditions, long-term cycles have the ability to produce gradual, and nevertheless, major shifts in the normal year-to-year range of hydrologic conditions. As climatic cycles become wetter, wetlands will tend to cover larger areas of the landscape. Wetland communities would also tend to become more diverse as a result of the presence of greater ranges of hydroperiods on different topographic sites. A wetter climate might also increase the rate of peat accretion in wetlands, thus encouraging the development of edaphic plant communities. Long-term drier conditions might produce the opposite effects. A wetter or dryer climate might also affect the frequency of fire, shifting plant community succession. A major difficulty in managing wetlands is our inability to distinguish between shifts

in hydrologic conditions that result from man's activities and those that result from occasional natural events or long-term shifts in climate (Duever, 1984).

Succession

Overdrainage of wetlands and reduction of hydroperiod length influences the direction of plant community succession within a wetland. McPhearson (1973) reported that "differences of only a few inches in depth or changes in period of inundation will determine, in time, what plant communities are present [in the Everglades]." Numerous investigators have documented changes in the species composition of south Florida plant communities resulting from altered water level conditions (Davis, 1943; Loveless, 1959; Kolipinski and Higer, 1969; Dineen, 1972, 1974; Alexander and Crook, 1973, 1988; Schortemeyer, 1980; Worth, 1983). The successional relationships of south Florida wetland and upland plant communities have been discussed by Alexander and Crook (1973), Craighead (1971), Davis, (1943), Wharton et al. (1977), and Duever, *et al.* (1986). This successional relationship is presented in Figure F-2. These data are useful for making a general assessment of the direction that succession may take as a result of increasing or decreasing hydroperiod in a Florida wetland.

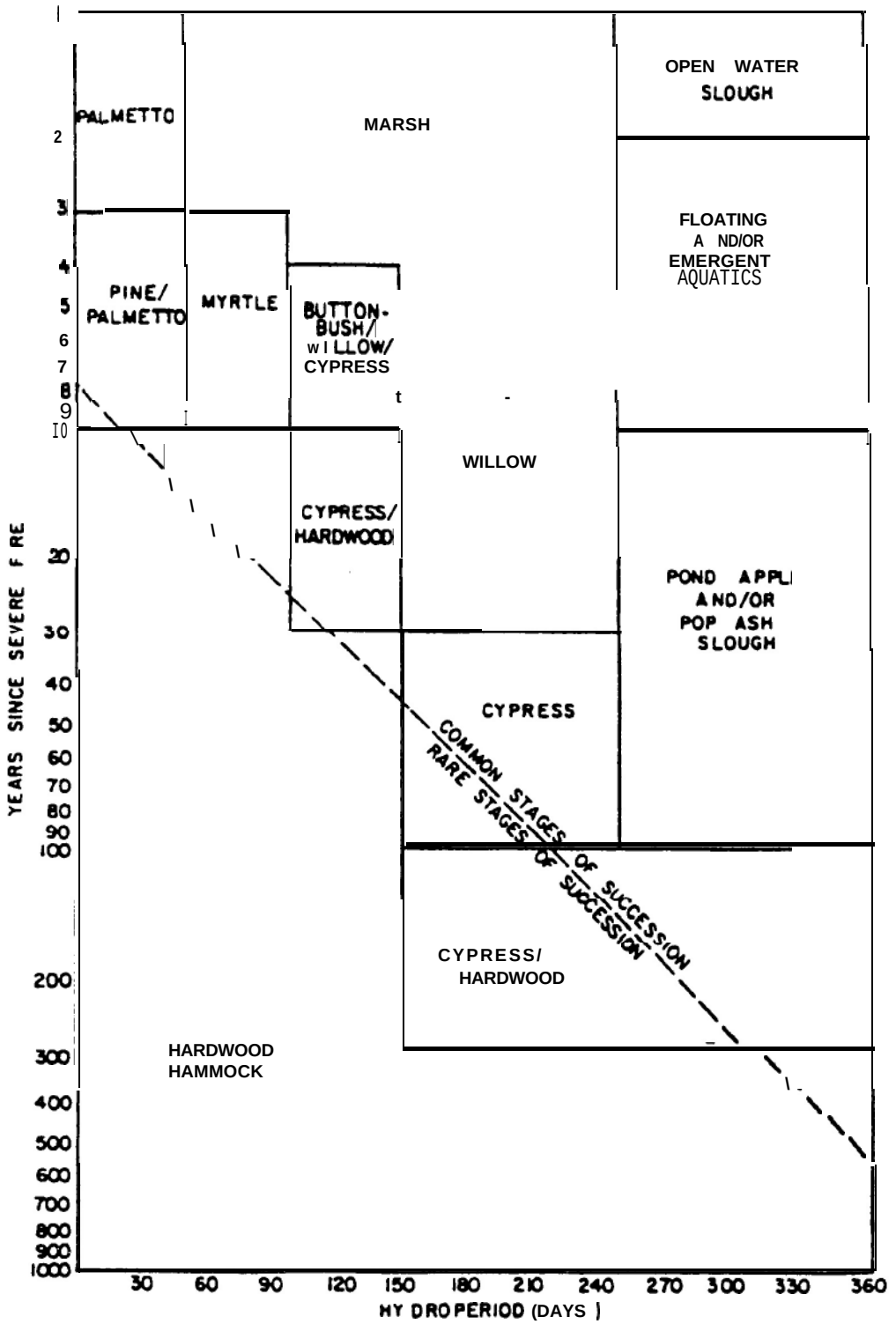

FIGURE F-2. Successional Patterns and Rates within South Florida Inland Plant Communities (From Duever, 1984).

Threatened, Endangered, and Species of Special Concern

TABLE F-l. Threatened, Endangered, and Species of Special Concern in Martin, St. Lucie, and Okeechobee Counties.

SPECIES	County	FGFC	FDA	USFWS
Mammals				
Florida Mouse *Podomys floridanus*	M,S	SSC		
Florida Panther *Felis concolor coryi*	M	E		E
Sherman's Fox Squirrel *Scuirus niger'shermani*	MS.0	SSC		
Southeastern Beach Mouse *Permyscus polionotus niveiven tris*	S	T		T
West Indian Manatee *Trichechus manatus*	MS.0	E		E
Birds				
American Oystercatcher *Haematopus palliatus*	M,S	SSC		
Arctic Peregine Falcon *Falco peregrinus*	M,S,O			
Audubon's Crested Caracara *Polyborus plancus audubonii*	M,S,O	T		T
Bald Eagle *Haliaeetus leucocephalus*	M,S,O	T		E
Black Skimmer *Rynchops niger*	M,S	ssc		
Brown Pelican *Pelecanus occidentalis*	M,S	SSC		
Florida Grasshopper Sparrow *Ammadramus savannarum floridanus*	0	E		E
Florida Sandhill Crane *Grus canadenses pratensis*	M,S,O	T		
Florida Scrub Jay *Aphelocoma coerulescens coerulescens*	MS.0	T		T
Least Tern *Sterna antillarum*	M,S,O	T		
Limpkin *Aramus quarauna*	M,S,O	SSC		
Little Blue Heron *Egretta coerulea*	MS.0	SSC		
Piping Plover *Charadrius melodus*	M,S	T		T
Red-Cockaded Woodpecker *Picoides borealis*	M			
Roseate Spoonbill *Aiaia ajaia*	M,S	SSC		
Snail Kite *Rostrhamus sociabilis plumbeus*	S	E		E
Snowy Egret *Egretta thula*	M,S,O	ssc		

County: M = Martin; S = St. Lucie; 0 = Okeechobee.

Species Designations: E = Endangered; T = Threatened; SSC = Species of Special Concern.

Agencies: FGFC = Florida Game and Fresh Water Fish Commission ▪ Jurisdictional over Florida's animals (vertebrates and invertebrates); FDA = Florida Department of Agriculture and Consumer Services ▪ Jurisdictional over Florida's plants; USFWS = United States Fish and Wildlife Service ▪ Jurisdictional nationally over plants and animals.

Source: The Nature Conservancy, 1990 and Florida Game and Fresh Water Fish Commission, 1993.

TABLE F-l. Threatened, Endangered, and Species of Special Concern in Martin, St. Lucie, and Okeechobee Counties (Continued).

SPECIES	County	FGFC	FDA	USFWS
Birds (Continued)				
Southeastern American Kestrel *Falco sparverius paulus*	M,S,O	T		
Tricolor Heron *Egretta tricolor*	M,S,O	SSC		
Wood Stork *Mycteria americana*	M,S,O	E		E
Reptiles				
American Alligator *Alligator mississippiensis*	M,S,O	SSC		
Atlantic Green Turtle *Chelonia mydas mydas*	M,S	E		E
Atlantic Hawksbill Turtle *Eretmochelys imbricata imbricata*	M	E		E
Atlantic Loggerhead Turtle *Caretta caretta caretta*	M,S	T		T
Eastern Indigo Snake *Drymarchon corais couperi*	M,S,O	T		T
Florida Pine Snake *Pituophis melandeucus mugitus*	S	SSC		
Gopher Tortoise *Gopherus polyphemus*	M,S,O	SSC		
Leatherback Turtle *Dermochelys coriacea*	M,S	E		E
Plants				
Beach Star *Remirea maritima*	M,S	T	E	
Burrowing Four O'Clock *Okenia hypogaea*	O		E	
Carter's Large-flowered flax *Linum carteri var smallii*	M		E	
Catesby's Lily *Lilium catesbaei*	M,S,O		T	
Curtiss' Milkweed *Asclepias curtissii*	M,S		E	
Dollar Orchid *Encyclia boothiana var erythroniodes*	M		E	
Fall Flowering Pleat-leaf *Nemeastylis floridana*	O		E	
Florida Keys Ladies' Tresses *Spiranthes polyantha*	M		E	
Fragrant Prickly Apple *Cereus eriophorus var fragrans*	S		E	
Hand Adder's tongue fern *Ophioglossum palmatum*	M,S		E	
Large Flowered Rosemary *Conradina grandiflora*	M,S		E	

County: M = Martin; S = St. Lucie; 0 = Okeechobee.
Species Designations: E = Endangered; T = Threatened; SSC = Species of Special Concern.
Agencies: FGFC = Florida Game and Fresh Water Fish Commission • Jurisdictional over Florida's animals (vertebrates and Invertebrates); FDA = Florida Department of Agriculture and Consumer Services • Jurisdictional over Florida's plants, USFWS = United States Fish and Wildlife Service -Jurisdictional nationally over plants and animals.
Source: The Nature Conservancy, 1990 and Florida Game and Fresh Water Fish Commission, 1993.

TABLE F-l. Threatened, Endangered, and Species of Special Concern in Martin, St. Lucie, and Okeechobee Counties (Continued).

SPECIES	County	FGFC	FDA	USFWS
Plants (Continued)				
Night Scent Orchid *Epidendrum nocturnum*	M,O		T	
Nodding Pinweed *Lechea cernua*	M,S		E	
Pepper *Peperomia humilis*	M,S		E	
Pine Pinweed *Lechea divaricata*	M		E	
Redberry Ironwood *Eugenia confusa*	M		T	
Simpson Zephyr Lily *Zephyranthes simpsonii*	M,O		E	
Spotless - Petaled Balm *Dicerandra immaculata*	S		E	
Twisted Air Plant *Tillandsia flexuosa*	M		T	
Vanilla *Vanilla mexicana*	M		T	
Venus Hair Fern *Adiantum capillus-veneris*	M		T	
Wild Coco *Pteroglossaspis ecristata*	M		T	

County: M = Martin; S = St. Lucie; 0 = Okeechobee.
Species Designations: E = Endangered; T = Threatened; SSC = Species of Special Concern.
Agencies: FGFC = Florida Game and Fresh Water Fish Commission ▪ Jurisdictional over Florida's animals (vertebrates and invertebrates); FDA = Florida Department of Agriculture and Consumer Services ▪ Jurisdictional over Florida's plants; USFWS = United States Fish and Wildlife Service ▪ Jurisdictional nationally over plants and animals.
Source: The Nature Conservancy, 1990 and Florida Game and Fresh Water Fish Commission, 1993.

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